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Application of Statistical Quality Control Methods to Sarong Product Quality at UD. Utomo Joyo

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Abstract
UD. Utomo Joyo has problems related to monthly production defects, where the company has a maximum defect target of 5% of total production for one period, but the defects that occur exceed estimates. This study aims to find solutions to improve the application of the Statistical Quality Control method to the quality of sarong products at UD. Utomo Joyo using Seven Quality Control Tools (7 QC), namely flowcharts, checksheets, histograms, control charts, pareto diagrams, scatter diagrams, and fishbone diagrams. The results of the analysis and discussion show that there are 2 types of product defects such as yarn break defects and color fade/flex defects, while the most common or dominant defect is yarn break defects with a percentage of 68.3%. The findings of these defective products are still within the control limits of UCL and LCL. The proposed improvements are rescheduling to check tools regularly, providing adequate and safe lighting facilities for eye health, providing SOP education to workers before starting work. The advice given is to provide more focus on the most common or dominant product defects, in order to reduce losses and increase customer satisfaction in the future.
Keywords: *seven tools, quality control, product defects, control chart, SQC*

Abstrak
UD. Utomo Joyo memiliki permasalahan terkait cacat produksi bulanan, dimana perusahaan memiliki target cacat maksimal 5% dari total produksi selama satu periode, tetapi cacat yang terjadi melebihi perkiraan. Penelitian ini bertujuan untuk mencari solusi perbaikan dari penerapan metode *Statistical Quality Control* pada kualitas produk sarung di UD. Utomo Joyo dengan menggunakan tujuh alat *quality control* (7 QC) yaitu *flowchart, checksheet, histogram, control chart,* diagram *pareto*, diagram *scatter*, dan diagram *fishbone*. Hasil analisa dan pembahasan diketahui ada 2 jenis kecacatan produk seperti cacat putus benang dan cacat warna luntur timbul flex, sedangkan cacat yang paling umum atau dominan adalah cacat putus benang dengan persentase 68,3%. Temuan produk cacat tersebut masih dalam batas kontrol UCL dan LCL. Usulan perbaikannya yang didapatkan yaitu melakukan penjadwalan ulang untuk pengecekan alat secara berkala, memberikan fasilitas penerangan yang cukup dan aman untuk kesehatan mata, memberikan edukasi SOP kepada pekerja sebelum memulai pekerjaan. Saran yang disampaikan adalah memberikan fokus yang lebih pada kecacatan produk yang paling umum atau dominan, agar mengurangi kerugian dan dapat meningkatkan kepuasan pelanggan di masa depan.
Kata Kunci: *seventools, pengendalian kualitas, cacat produk, peta kendali, SQC*

1. Introduction

As the number of industry players continues to increase, one of the things that companies must pay attention to is the quality of their products. As one of the most important processes in the industrial process chain, quality control needs to be carried out with precision and care [1]. To ensure the quality of the product is good and suitable for sale, it is necessary to carry out inspection [2]. A significant problem for businesses is the issue of defective goods. Products that have been damaged often result from manufacturing processes, carelessness at work and lack of supervision during production [3]. Quality control is very important for an organization to fulfill orders for delivered goods to comply with the standards set by the organization as well as the guidelines set by the environmental and global agencies that oversee quality standardization. clearly define and adhere to what the buying organization normally anticipates [4]. To carry out quality control, tools are needed that can be used to assist the quality control process, including the seven tools [5].

UD. Utomo Joyo is a home industry that produces silk sarongs that prioritizes quality in its products, production in this place still traditionally uses ATBM (Non-Machine Weaving Tools). UD. Utomo Joyo's production facility, located in Gresik Regency and has been in the process since 2002. UD. Utomo Joyo has problems related to monthly production defects, where the company has a maximum defect target of

5% of total production for one period, but the incidence of product defects exceeds estimates. Based on this information, approaches and observations are made to overcome the problems that have occurred.

Figure 1. Sarong Production Process (Weaving)
Source: UD. Utomo Joyo, 2022

Figure 2. Sarong Production Process (reveal)
Source: UD. Utomo Joyo, 2022

The following is previous research that discusses quality control, including the research entitled “Analysis of Banner Quality Control Using the Seven Quality Control Tools (7 QC) Method at PT. Fajar Interpratama Mandiri (Fim Printing)” used to identify product defects during the production process. Based on the research findings, there were three types of defects on banners, namely due to the cutting result of 29.1%, the result of printing was 33.3%, and the result of hot pressing was 37.7% [6]. The research entitled "Quality Control of UMKM Bagus Bakery by Using the Seven Tools Method" used to identify failures during the production process.

Test results based on the seven tools method for overcoming bantet bread using up to 10 grams of fermipan and 15 grams of bread improver, cleaning the equipment every time the dough is made, oil temperature between 165~175°C produces the smallest production failure value [7]. The research entitled "Analysis of Product Quality Control for Packaging Cardboard Box PT. X by Using the Statistical Quality Control Method” used to identify the types and factors that can result in defective products. Based on research findings, it is known that the most common types of product damage are improper shape, dirty, and wrong size. Human factors, machines, equipment, and the environment are the causes of damage to carton box packaging products, according to observations and interviews [8].

Based on the above problems, this study aims to find solutions to improve the application of the Statistical Quality Control (SQC) method on the quality of sarong products at UD. UTOMO JOYO with seven tools. The types of seven tools used in this study are flowcharts, check sheets, histograms, control charts, pareto diagrams, scatter diagrams, cause-and-effect diagrams or known as fishbone.

2. Material and Method

Research conducted at UD. Utomo Joyo is located in Gresik Regency, East Java. In this study, quality control of sarong products was carried out using the Statistical Quality Control method for the types of defects found during sarong production. Data taken from January 2022 to December 2022. The following are the research steps:

a. Problem Identification Stage: This stage is the process of identifying problems at UD. Utomo Joyo, which will be solved through the research carried out. The results of the identification show that there is a problem with defects in the sarong production section.
b. Data Collection Stage: At this stage data collection was carried out through interviews, and problems were found such as thread breaking defects and color fading defects arising in flex.
c. Data Processing Stage: At this stage data processing is carried out using the Statistical Quality Control method using seven tools, namely flowcharts, check sheets, histograms, control charts, pareto diagrams, scatter diagrams, fishbone diagrams.

d. Discussion Stage: This stage identifies the root of the problem using a cause-effect/Fishbone diagram and provides suggestions for improvement.

3. Result and Discussion

Analysis and discussion are used to solve research problems regarding defects found in sarong production at UD. UTOMO JOYO, the level of defects that occur exceeds the estimate that production in 2022 should have been 4,800 with 5% defects of 240, but defects that occurred were 445 or 9.27%. Therefore, the application of the Statistical Quality Control (SQC) method with the seven tools is expected to produce improvement suggestions which will be explained to UD. Utomo Joyo. The results of the initial data processing became the basis for the analysis and discussion in this study.

3.1. Flowchart Stage

Flowchart is a step-by-step product visualization tool that aims to simplify the analysis of defective products during the manufacturing process [9]. The process of making this sarong consists of several steps and must be done carefully and carefully. In **Figure 3** is a flow chart of the sarong manufacturing process.

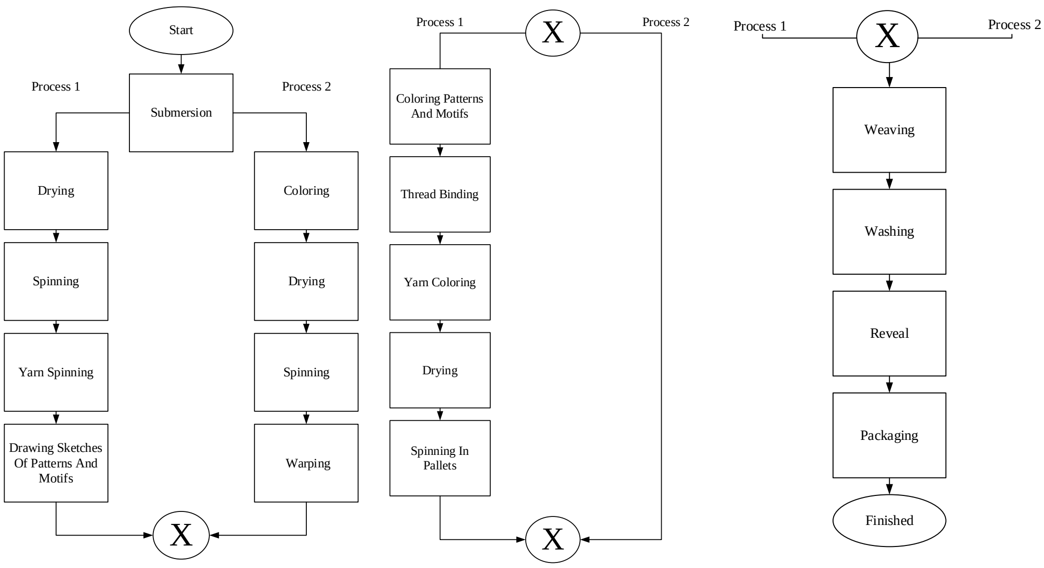

Figure 3. Sarong Production Process Flow Chart
Source Researcher, 2022

3.2. Data Check Sheet Examination Phase

A check sheet is a check sheet designed to simply provide a list of things to record. Thus, when data arrives at the scene, it can be collected easily, systematically, and frequently [10]. Information data related to the number of product defects obtained, recorded in a check sheet and presented in **Table 1.**

Table 1. Data for Defective Products January 2022 to December 2022

Month	Number of Production (Pcs)	Type of Defect (Pcs)		Number of Defective Products (Pcs)
		Thread Breaking Defect	Color Fading Defects Arising In Flex	
January	400	26	14	40
February	420	23	13	36
March	440	24	11	35
April	400	25	10	35
May	400	26	13	39
June	380	22	13	35
July	400	25	10	35
August	400	29	10	39
September	380	24	12	36
October	400	30	12	42
November	400	20	12	32
December	380	30	11	41
Amount	4800	304	141	445

Source: Results of Data Analysis, 2022

Based on the information in **Table 1,** production that has taken place from January 2022 to December 2022, the company received two types of defects, namely 304 thread break defects, and 141 flex and fade color defects, with a total product defect of 445 out of a total production of 4800 in year 2022.

3.3. Histogram identification

A histogram is a graphical representation that provides a visualization to show the distribution of data or how often different values appear in a data set. The use of a histogram has the advantage of providing information about process variations and assisting management in making decisions regarding continuous process improvement efforts [11]. The image below is the result of processing the histogram data in **Table 1.**

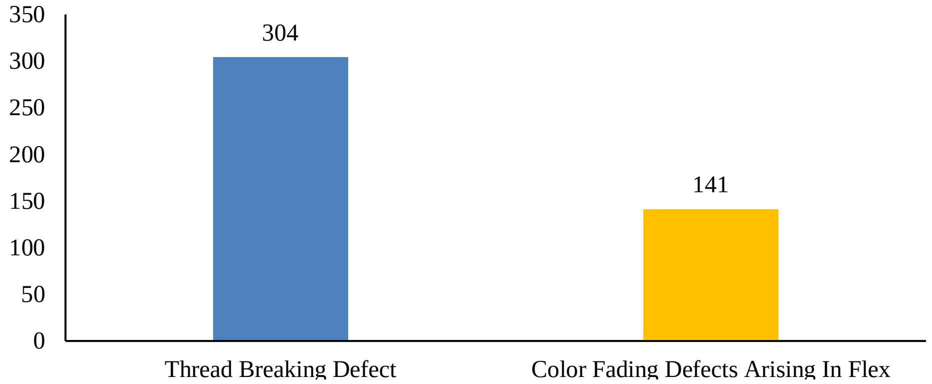

Figure 4: Histogram Results of Types of Disability (Pcs)

Source: Results of Data Processing, 2022

Based on **Figure 4,** the data concludes that there are two types of production defects. The type of thread breaking defect has the greatest value, this can happen because the operator sometimes forgets to check the thread during the weaving process.

3.4. Calculating the Control Map (P-Chart)

P control chart, which is a map used to see the proportion of daily defects for the sample group examined, this control chart can be used to analyze defective products [12]. From the data in **Table 1** above, the calculation of the P control chart is carried out. Here's how to calculate it:

1) Determining the Proportion of Defects
Here's the calculation formula:

$$p = \frac{np}{p}$$

Information:
np : number of failures in the subgroup
n : the number examined in the subgroup
Subgroup : month to -
How to calculate the data is as follows:

$$p = \frac{np}{p} = \frac{40}{400} = 0{,}100$$

2) Determine the Center Line (CL)
The average product breakdown is indicated by the center line (p̅)
Here's the calculation formula:

$$CL = \bar{p} = \frac{\sum np}{\sum n}$$

Information:
$\sum$np : total amount damaged
$\sum$n : the total number examined
How to calculate the data is as follows:

$$CL = \bar{p} = \frac{\sum np}{\sum n} = \frac{445}{4800} = 0{,}093$$

3) Determine the Upper Control Limit (UCL)
Here's the calculation formula:

$$UCL = \bar{p} + 3\sqrt{\frac{\bar{p}(1-\bar{p})}{n}}$$

Information:
p̄ : average product non-conformance
n : production amount
How to calculate the data is as follows:

$$UCL = 0{,}169 + 3\sqrt{\frac{0{,}100\ (1 - 0{,}100)}{400}} = 0{,}136$$

4) Determine the Lower Control Limit (LCL)
Here's the calculation formula:

$$LCL = \bar{p} - 3\sqrt{\frac{\bar{p}(1-\bar{p})}{n}}$$

Information:
p̄ : average product non-conformance
n : production amount
How to calculate the data is as follows:

$$LCL = 0{,}169 - 3\sqrt{\frac{0{,}100\ (1 - 0{,}100)}{400}} = 0{,}049$$

Table 2. Recapitulation of P Control Map Calculation Results

Month	Number of Production (Pcs)	Number of Defective Products (Pcs)	P	CL	UCL	LCL
January	400	40	0.100	0.093	0.136	0.049
February	420	36	0.086	0.093	0.135	0.050
March	440	35	0.080	0.093	0.134	0.051
April	400	35	0.088	0.093	0.136	0.049
May	400	39	0.098	0.093	0.136	0.049
June	380	35	0.092	0.093	0.137	0.048
July	400	35	0.088	0.093	0.136	0.049
August	400	39	0.098	0.093	0.136	0.049
September	380	36	0.095	0.093	0.137	0.048
October	400	42	0.105	0.093	0.136	0.049
November	400	32	0.080	0.093	0.136	0.049
December	380	41	0.108	0.093	0.137	0.048

Source: Results of Data Processing, 2022

Based on **Figure 5**, the results of calculating defective products during production in 2022 at UD. UTOMO JOYO, it can be seen that there is no defect data that exceeds the tolerance limit of the P control chart. Therefore, the production process at UD. UTOMO JOYO can be assessed as still in a stable condition

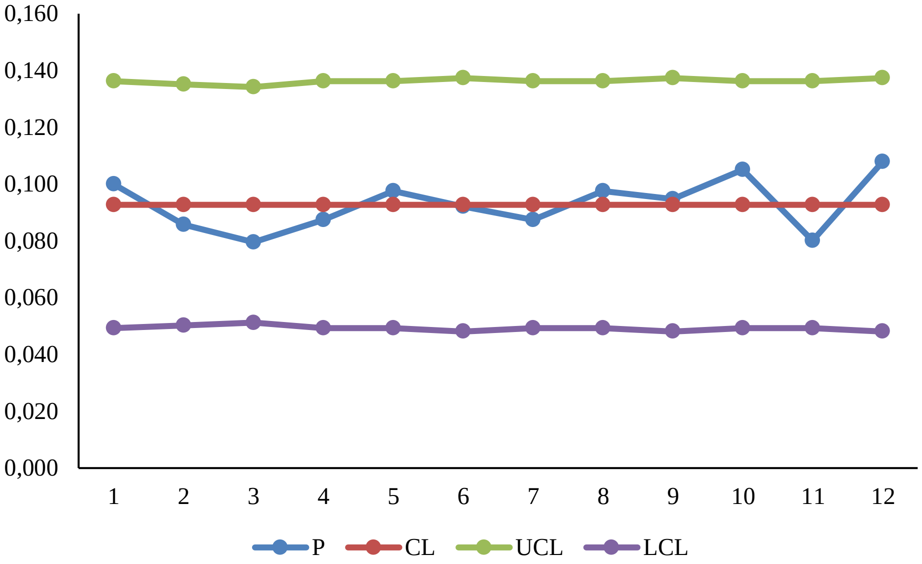

Figure 5. P-Chart Results
Source: Results of Data Processing, 2022

3.5. Identify Pareto Charts

Pareto charts can help you focus on areas of failure as opportunities for improvement when managing bugs, issues, or scrap [13]. The pareto diagram in this study aims to identify the factors that cause the most common or dominant defects in the sarong manufacturing process, so that improvements can be prioritized for these problems. The results of the Pareto chart created are shown in **Figure 6.**

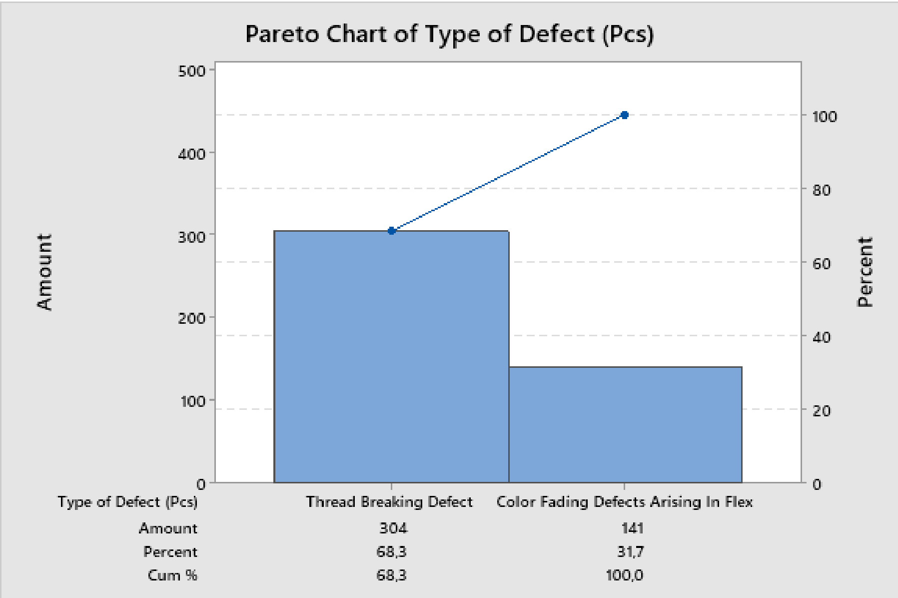

Figure 6. Pareto Chart Results of Types of Disability (Pcs)
Source: Results of Data Processing, 2022

Based on the Pareto diagram in **Figure 6,** it clearly shows that in the 2022 period. The most numerous or dominant quality characteristics will cause defective products, the most common defects occurring with the type of thread breaking defect are 304 products, namely 68.3%. Thus, the priority of quality control that will be carried out can be focused on reducing yarn breaking defects.

3.6. Identify Scatter Charts

Scatter diagrams or other terms are called scatter diagrams, which aim to show the relationship of a cause to an effect or the closeness of two data [14]. In this problem, the two data are looking for a correlation between the types of product defects and the amount of production.

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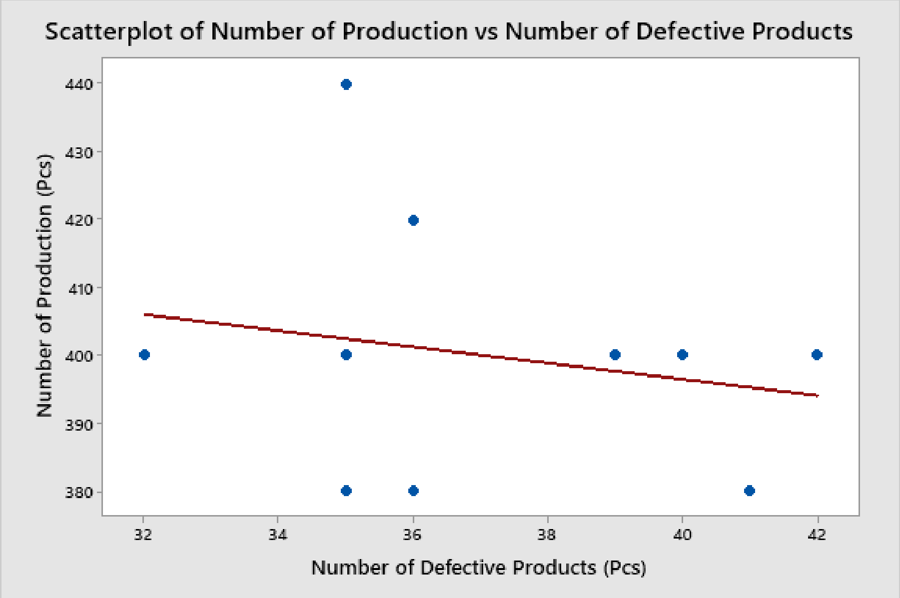

Figure 7. Results of the Scatter Diagram from the Amount of Production (Pcs) and the Number of Defective Products (Pcs)
Source: Results of Data Processing, 2022

Based on the results of the graph shown in **Figure 7,** the scatter diagram above has a negative relationship (negative correlation). This shows that the number of defective products will have an impact on the amount of production which is always high if solutions are not immediately sought for repairs.

3.7. Problem Solver with Fishbone Diagrams

A fishbone diagram is useful for illustrating the main issues and factors affecting quality. Radial arrows pointing in the wrong direction indicate the cause of the error. The purpose of a cause and effect diagram is to break down the state and end result of a problem, reveal the underlying causes of the problem, and provide a clear picture of the sources of variation [15]. Fishbone analysis found four findings which are the main causes of defects in the sarong production process, namely by human factors, tool factors, method factors, and environmental factors. Here are the findings:

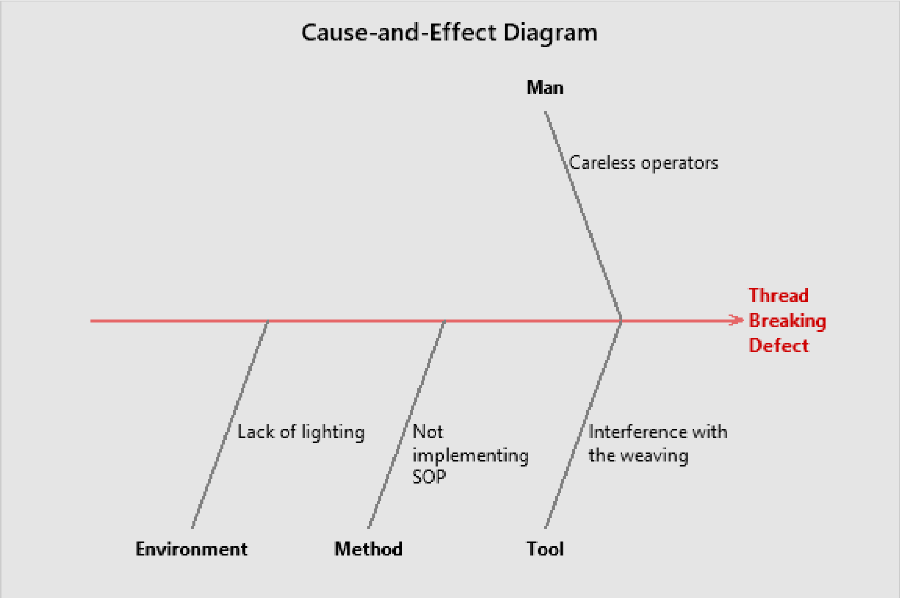

Figure 8. Result of Fishbone Breaking Defects Thread
Source: Results of Data Processing, 2022

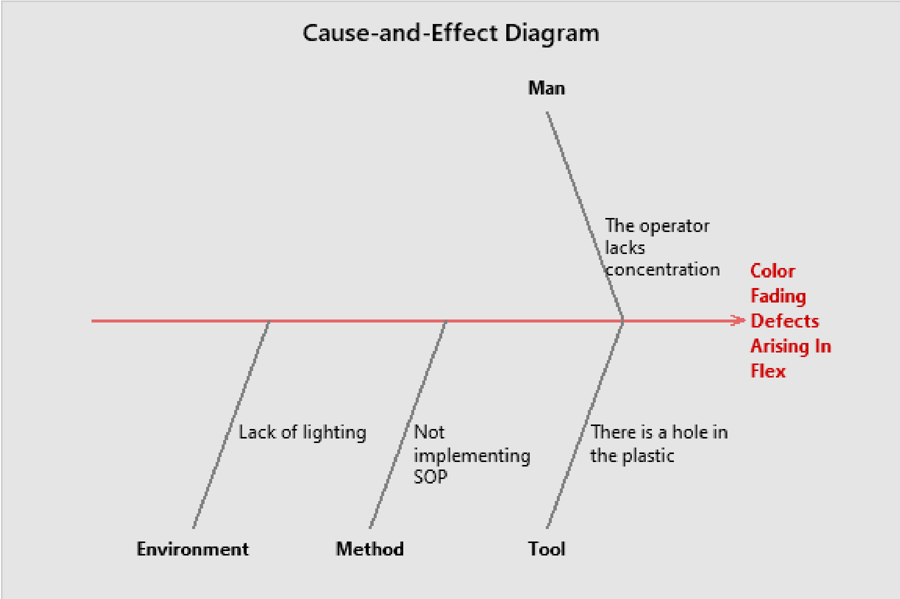

Figure 9. Result Fishbone Defects Color Fades Arise Flex
Source: Results of Data Processing, 2022

The results of the fishbone diagram analysis above, then proposed improvements as follows:
1) Rescheduling for regular tool checks
2) Providing adequate and safe lighting facilities for eye health
3) Provide SOP education to workers before starting work

4. Conclusion

The results obtained from the application of the Statistical Quality Control method using seven tools show that during January 2022 to December 2022 there were 2 types of product defects, namely thread breaking defect and color fading defects arising in flex, while the most common or dominant defect was thread breaking defect with a percentage of 68,3%. From the fishbone diagram, it is known that the dominant level of defective product thread breakage can be caused by operators who are not careful or interference with the tool. In addition, the results of the control chart show the findings of defective products are still within the limits of UCL and LCL. The finding of defects in these products requires an improvement, such as rescheduling for periodic checks of tools, providing sufficient and safe lighting facilities for eye health, providing SOP education to workers before starting work. The advice given is to provide more focus on the most common or dominant product defects, in order to reduce losses and increase customer satisfaction in the future.

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